eYSIP2017

Tiva Based Daughter Board For Firebird V.

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Duration of Internship: 22/05/2017 – 07/07/2017

2017, e-Yantra Publication

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Abstract

The objective of the project was to design two daughter boards for firebird V which has following features:

- Compatible With TIVA based platform.
- must support all the necessary features of firebird.

The deliverables expected were

- 2 working daughter boards one with tiva launch pad and another with the Tiva TM4C123GH6PM.
- Hardware and software manual for anyone using it in future.
- All the demo codes for assistance.

Completion status

The project was divided in many small tasks which were to be completed in given time. Though we refrain from mentioning that long list but still will give some important one.

- Learning Tiva Platform.
- Finding solution for limitations offered by Tiva, like limited GPIO pins and limited ADC channels.
- Utilizing the functionality provided to the maximum.
- Creating schematic and layout for the daughter boards.

- Testing the boards and writing all the test codes.
- Making hardware and software manuals.

1.1 Hardware parts

- List of hardware used :
  - Tiva launchpad.
  - TM4C123GH6PM.
  - MCP23017 port expander.
  - ADC128D818 external adc.
  - Voltage regulator(lm1117,7805).
- Detail of each hardware:
  1. Tiva Launchpad: It is a micro-controller board by Texas Instruments that has on board programmer with real time debugger feature. The micro-controller is very efficient with system clock up to 80MHz and CAN protocol. The tutorial and more information can be read from Datasheet,,
  2. TM4C123GH6PM is a ARM cortex M4 based micro-controller that is used as a controller of the Tiva Launchpad. You can read Datasheet for more details.
  3. Voltage Regulators:The voltage source available on the Firebird is 9.6V. But the TIVA platform works on 3.3V and the servos can operate upto 6V. So there must be 3 different voltage levels on the board. The uC based board has 2 voltage regulators and the plug and play board has 1 voltage regulator. In the uC based board the 9.6 volts is regulated 3.3V to power the micro-controller. In the plug and play board the there is an inbuilt voltage regulator, so it is directly connected connected to 5v, 300mA source. The servo in both the boards has a separate 5V regulator. Datasheets for3.3 volts regulator lm1117, and 5 volts regulator 7805 5 volts regulator can be accessed from the links,
  4. Level Converters TIVA platform operates at 3.3V and the Firebird operates at 5V. Directly connecting these pins to the TIVA may be fatal. So to for proper level maintenance, a level converter is used. A bidirectional MOS- FET based level converter used.

The level converter is necessary is for input pins. In the boards Level converter is used for interfacing the position encoders of the motors. Datasheet of MOSFET is also provided.

5. Port Expander(MCP23017):TM4C123GH6PM has only 64 pins out which only 43 are GPIO pins. This limits our application to read input and respond correspondingly. To increase the number of GPIO and there interrupts we have used I2C compatible a port expander MCP23017. It has 2 PORTS A and B, with each port having 8 Pins.The interrupts on each pin can also be monitored. To read more about it, download the datasheet from here.The schematic of the connection is shown below.Keep in mind that I2C SCL and SDA have already been pulled up using 10K resistor.Datasheet of the port expander can be fount here.
6. Serial Communication
7. External Adc It has already been mentioned that adc channels on the microcontroller is limited to 12 while

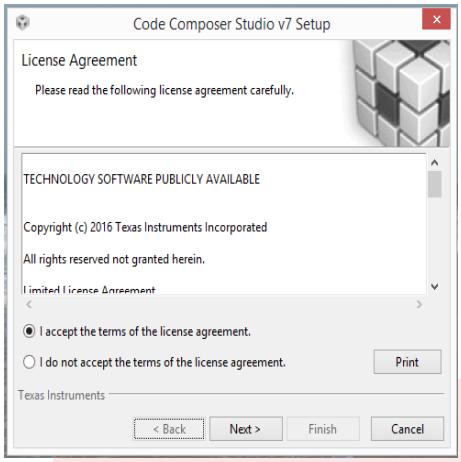
   rebird has 22 sensors available. We have interfaced an external ADC which is also I2C compatible. It has 8 channel with 12 bit resolution.To read more about it, download the datasheet from here.The schematic of the connection is shown below.Keep in mind that I2C SCL and SDA have already been pulled up using 10K

- Connection diagram

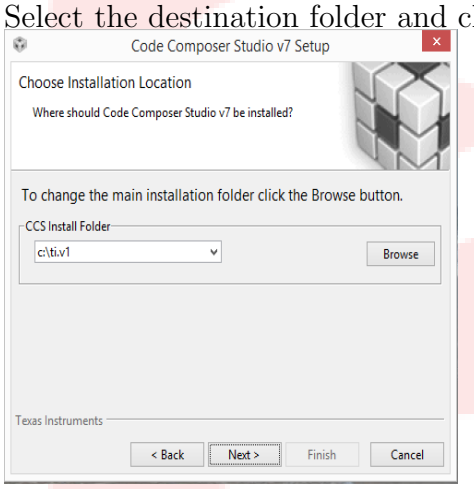
1.2 Software used

- Code Composer Studio
- Detail of software: version, 7.1.0 download link,
- Installation steps After the installer has started follow the steps mentioned below:

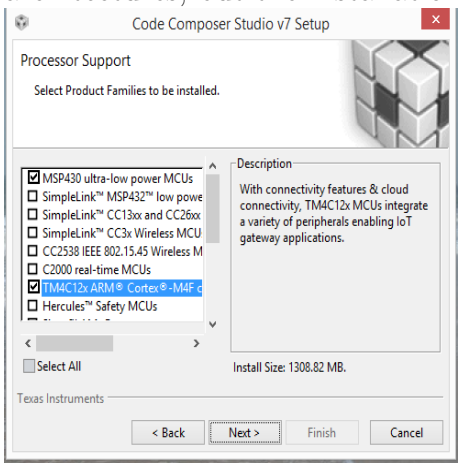
1. Accept the Software License Agreement and click Next.



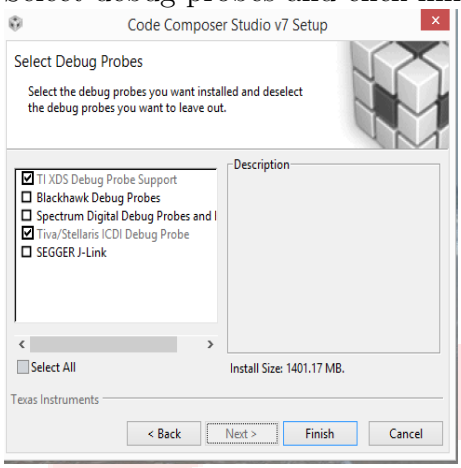
2. Select the destination folder and click next.



3. Select the processors that your CCS installation will support. You must select "TM4C12X Arm Cortex M4". You can select other architectures, but the installation time and size will increase.



4. Select debug probes and click finish



5. The installer process should take 15 - 30 minutes, depending on the speed of your connection. The offline installation should take 10 to 15 minutes. When the installation is complete, uncheck the Launch Code Composer Studio v7 checkbox and then click Finish.There are several additional tools that require installation during the CCS install process. Click Yes or OK to proceed when these appear.

6. Install TivaWare for C Series (Complete). Download and install the latest full version of TivaWare from: TivaWare. The filename is SW-TM4C-x.x.exe . This workshop was built using version 1.1. Your version may be a later one. If at all possible, please install TivaWare into the default location.

1.3 Assembly of hardware

Circuit diagram and m,¿Steps of assembly of hardware with pictures for each step

Circuit Diagram

Circuit schematic, simplified circuit diagram , block diagram of system

Step 1

Steps for assembling part 1

Step 2

Steps for assembling part 2

Step 3

Steps for assembling part 3

1.4 Software and Code

Github link for the repository of code

Brief explanation of various parts of code

1.5 Use and Demo

Final Setup Image

User Instruction for demonstration

Youtube Link of demonstration video

1.6 Future Work

What can be done to take this work ahead in future as projects.

1.7 Bug report and Challenges

Any issues in code and hardware.

Any failure or challenges faced during project

Bibliography

[1] Ad Kamerman and Leo Monteban, *WaveLAN-II: A High-Performance Wireless LAN for the Unlicensed band*, 1997.